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UNDERCABINET LIGHTING WITH LIGHT EMITTING DIODE SOURCE

BACKGROUND OF THE INVENTION

Field of the Invention

This invention pertains to an apparatus for improving the performance of undercabinet lighting by providing a longer lighting life and higher efficacy. More particularly, the invention relates to improving undercabinet lighting by replacing a standard fluorescent or incandescent lamp with a light emitting diode (LED) light source.

Discussion of the Art

Conventional undercabinet lighting utilizes fluorescent or incandescent lamps as a light source. Fluorescent and incandescent lamps generally require filaments and cathode tubes for operation. They are fragile and require careful handling and, in addition, filament lamps have a relatively short operating life. Furthermore, filament lamps are not the most economical. Fluorescent lamps have a relatively high start up power consumption. Accordingly, new ways to provide more efficient lighting are constantly under consideration.

Light Emitting Diodes (LEDs) have made significant advances in providing a higher performing light source since their inception in the 1960's. Red-emitting AlGaAs LEDs were developed with external quantum efficiencies greater than 10%, such devices being more energy efficient and longer lasting producers of red light than red-filtered incandescent bulbs. As a result, LEDs have become cost effective replacements for standard incandescent light sources in various applications, such as automotive brake lights. Moreover, high-efficiency LEDs have been developed and are commercially available in the blue and blue/green wavelength range based on the InGaN and AlGaN material systems. Most recently, LEDs have been developed in the green and yellow color range with an external quantum efficiency greater than 1%.

The advent of UV and blue LEDs allowed the possibility to generate white light from an LED by applying luminescent phosphor materials on top of the LED. This layer of phosphor partially transforms the UV or blue light into longer wavelengths, e.g. yellow light. Successful implementation of such a device is dependent upon the efficient conversion of UV/blue light into visible light of the desired wavelength and the subsequent efficient extraction of the generated visible light from the device. However, the first commercially available white light LED systems were not competitive with standard light sources with respect to performance since the phosphor layer only partially transformed the UV or blue light into longer wavelengths. Not until recently have devices and methods been developed for efficiently converting UV/Blue light into visible light.

White-light LED systems provide significant benefits over traditional fluorescent and incandescent lamps. As white light producing LED systems become more refined and efficient, a need exists to expand the use of such systems into other areas, such as undercabinet lighting. As already discussed, the current fluorescent and incandescent lamps used in undercabinet lighting have multiple components (increasing the cost to manufacture), are fragile, and have a relatively short operating life. Furthermore, conventional undercabinet lighting is subject to failure upon power outages. Constructing undercabinet lighting with an LED as its light source and a battery back-up system would alleviate most, if not all, of the foregoing problems. To date, no device exists which adequately utilizes an LED system in undercabinet lighting. Therefore, it would be advantageous to provide an LED light source for undercabinet lighting which replaces the traditional filament or fluorescent lamp with an LED light source.

BRIEF SUMMARY OF THE INVENTION

A new and improved apparatus is provided for improving the performance of undercabinet lighting by replacing the fluorescent and incandescent lamps found in traditional undercabinet lighting assemblies with a light emitting diode.

An improved undercabinet lighting assembly includes a fixture or housing. A first plurality of light emitting diodes (LEDs) is mounted within the housing forming at least one array of LEDs. The array of LEDs serves as a light source and generates a light pattern. At least one optical assembly is operatively associated with the housing for focusing and dispersing the light pattern.

One advantage of the present invention is the provision of undercabinet lighting having a longer lighting life and increased reliability.

Another advantage of the present invention resides in the reduced cost of manufacturing undercabinet lighting due to the decreased number of required components.

Another advantage of the present invention is the provision of an undercabinet lighting assembly having a minimal cost of operation due to the inherently low power consumption of the device.

Another advantage of the present invention is provided by a battery back-up system which allows for emergency lighting in the case of primary power failure.

Another advantage of the present invention is provided by the ability to control the life of a battery source used for the battery back up system.

Yet another advantage of the present invention is the provision of undercabinet lighting capable of being manufactured having several different shapes.

Yet another advantage of the present invention is the provision of emergency powerfail lighting which is energized upon primary power failure.

Still another advantage of the present invention is the provision of a switch in the form of a variable resistor allowing control over the intensity of and the number of LEDs in operation.

Still other benefits and advantages of the invention will become apparent to those skilled in the art upon a reading and understanding of the following detailed specification.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1 is a perspective view of an undercabinet lighting assembly in accordance with the present invention.

FIGURE 2 is bottom view of an undercabinet lighting assembly in accordance with the present invention.

FIGURE 3 is a bottom view of another preferred undercabinet lighting assembly in accordance with the present invention.

FIGURE 4 is a cross sectional view of an undercabinet lighting assembly in accordance with the present invention.

FIGURE 5 is an enlarged view of a step level variable switch in accordance with the present invention.

FIGURE 6 is an enlarged view of a combined step level and continuous level variable switch in accordance with the present invention.

FIGURE 7 is a bottom view of another preferred undercabinet lighting assembly in accordance with the present invention.

FIGURE 8 is a perspective view of a flexible undercabinet lighting assembly in accordance with the present invention.

DETAILED DESCRIPTION OF THE INVENTION

FIGURE 1 shows a perspective view of an undercabinet lighting assembly **A** in accordance with the present invention. The lighting assembly includes a fixture or housing **10** enclosing the necessary lighting components and circuitry. The housing is defined by four side walls **12**, **14**, **16**, **18** and an upper and lower face **20**, **22**. The housing is preferably rectangular in shape, but any other shape is contemplated by the present invention. A fixing apparatus **24** is located on the upper face **20** of the housing. The fixing apparatus may include magnets, fixing posts, or keyholes adapted to receive the flanged heads of fasteners.

With continued reference to FIGURE 1, and further reference to FIGURE 2, a plurality of light emitting diodes (LEDs) **26**, mounted within the housing **10**, operate as the light source for the undercabinet lighting assembly **A**. The LEDs of the present invention replace the standard fluorescent or incandescent lamp and associated hardware, such as ballasts and sockets, that are used in conventional undercabinet lighting. The plurality of LEDs from which the light source is made, form at least one array of LEDs. In the illustrated embodiment, three LED arrays **28**, **30**, **32** are shown, each grouped in a substantially circular configuration. However, it will be appreciated that any number of LED arrays, grouped in any desired configuration are within the scope and intent of the present invention. For example, the LEDs may be placed in rows forming linear arrays **34**, **36**, **38** as best shown in FIGURE 3. The LEDs **26** in each array can be formed of multiple colors of spectral output, thereby giving the desired light output, light level, and beam characteristics.

Each LED array forming the light source includes an optical assembly **40** (see FIGURE 4) for focusing and dispersing an LED beam emitted by the LED array. Included is a part of the optical assembly are one or more reflectors and one or more lenses to provide directional control. The optical assembly **40** is adapted to move or rotate so that the focus of the lens and the dispersion of the LED beam can be adjusted as desired. Alternatively, the focus and dispersion may be adjusted by fixing the optical lens and allowing the LED array to move or rotate. In order to adjust the lens or LED array, a manually operated focusing knob **42** (see FIGURE 1) is provided

on one of the sidewalls **18** of the housing **10**. However, any other known means for adjusting the optical lens or LED array is contemplated by the present invention.

A switch **44**, coupled to a variable resistor **46**, is provided on the exterior of the housing **10** for allowing variable optical output. The switch **44** can be designed as a rheostat so that it is possible to change the resistance value without interrupting the circuit to which it is connected. As such, a user may adjust the optical output to any desired level.

Alternatively, or in addition to the rheostat design, the switch **44** can be designed having step level variable control which allows a user to choose from distinct levels of illumination as shown in FIGURE 5. In FIGURE 5, a rotatable switch **44** is shown with indicia representative of four different illumination levels or choices. In order to actuate the light source, the switch is pressed in the axial direction thereby illuminating the lamp. After the light has been turned on, the level of optical output may be adjusted by rotating the switch. In the illustrated embodiment, the switch can be rotated to four distinct positions **50**, **52**, **54**, **56** corresponding to four different levels of optical output. For each 90° of rotation, the level of optical illumination increases, for example, by 25% until full illumination is achieved at a twelve o'clock position. It will be appreciated however that any number of positions corresponding to any level of optical illumination is contemplated by the present invention. For example, the switch may be designed having two modes of illumination. Turning to FIGURE 6, the first mode **60** provides full illumination while the second mode **62** provides partial illumination. When operating at partial illumination, the undercabinet light source is equivalent to a night-light. As illustrated, such a design may be used in conjunction with a rheostat variable resistor.

In addition to allowing the user to adjust the optical output of the light source, the switch **44** may be adapted to enable the user to selectively turn on and off any number of LEDs in each array. In order to achieve such a feature, the variable resistor **46** is designed to selectively short-circuit predetermined sections of the resistor or switch certain LEDs out of the circuit. Therefore, the user can operate the switch to selectively turn on and off any number of LEDs as desired.

Returning now to FIGURE 1, the undercabinet lighting assembly is preferably connected to a power source, such as an AC power source, via cord **64** adapted to plug into any conventional electrical outlet (not shown). However, due to the inherent high efficiency of the device, the power source may be a capacitor or any other energy storage means. In addition to the primary power source, a battery back up system **70** is provided. The battery back-up system allows for emergency lighting upon failure of the AC source. The battery system includes a cavity **72,** disposed in one of the walls of the housing, which operates as a battery compartment **72** for containing batteries **74**. The batteries can be of any desired type and size, including but not limited to alkaline, nickel cadmium, standard, heavy duty, lithium, nickel metal hydride and other. A power source selector **76** is provided on one of the sides **18** of the housing which determines what source of power the lamp will use during operation. An AC power source indicator **78** and a battery source indicator **80** are disposed on the front side **14** of the housing **10** for indicating which source of power is being utilized. One skilled in the art will appreciate that the battery life can be controlled by the switch **44**.

In an exemplary embodiment, the battery back up system **70** is adapted to automatically turn on the light source upon failing or faulting of the primary power source. A sensor (not shown) detects when AC power is no longer available and sends a signal to the battery system to supply power to the light source. A power-fail switch **82** is provided on one of the sides of the housing for setting, testing, and resetting the power-fail system. Optionally, the undercabinet lighting assembly includes at least one lighting rail **84** (see FIGURE 7) having a plurality of LEDs arranged linearly across the bottom face of the housing. In the illustrated embodiment, two lighting rails are disclosed. Upon primary power failure, the battery system **70** operates to activate the lighting rails and provide illumination. This feature is particularly useful during the night.

Referring now to FIGURE 8, the housing of the undercabinet lighting assembly may be a flexible material such as rubber or an elastomeric material. As such, the housing can be bent into any shape or configuration as desired. The flexible housing **10** allows the user to utilize the light source in several different environments.

Such a feature may be achieved because of the unique characteristics of LEDs. LED light sources have significantly fewer components than standard fluorescent or incandescent lamps. In addition, unlike standard fluorescent and incandescent lamps, LEDs do not have fragile parts such as filaments, electrodes, etc. Therefore, LED light sources do not require a large housing made from a protective rigid material and can thus be made of a flexible material.

The invention has been described with reference to the preferred embodiment. Obviously, modifications and alterations will occur to others upon a reading and understanding of this specification. The invention is intended to include all such modifications and alterations in so far as they come within the scope of the appended claims and the equivalents thereof.